NOTE

INTERNATIONAL LIABILITY IN ASTEROID DEFLECTION

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INTRODUCTION

What do you do when a 200-meter asteroid rushes down at 20 kilometers per second to hit the ground where you live, bringing earthquakes, fires, and perhaps tsunamis?[1] If you can, you flee. But what do you do if that same asteroid is supposed to crash-land on the other side of the world but another State nudges the asteroid so that you find yourself and your worldly belongings in its crosshairs? You run if you can, and then seek to be made whole.

Scientists know of thousands of asteroids that may approach Earth in the near future. These asteroids, because their orbits bring them so close to Earth, are classified as near-Earth objects (NEOs).[2] The most dangerous NEOs are labeled potentially hazardous asteroids (PHAs).[3] PHAs are asteroids that have the highest likelihood of colliding with the Earth.[4] The record of collisions that the Earth has sustained reveals the substantial damage that these asteroids can cause when they impact the planet.[5] Teams of researchers stationed around the globe now devote themselves to mapping the trajectories of NEOs and PHAs, as well as developing sophisticated methods of deflecting them from a dangerous

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1. *See* Victoria Garshnek et al., *The Mitigation, Management, and Survivability of Asteroid/Comet Impact with Earth*, 16 SPACE POL'Y 213, 213–14 (2000).

2. Massimiliano Vasile & Camilla Colombo, *Optimal Impact Strategies for Asteroid Deflection*, 31 J. GUIDANCE, CONTROL & DYNAMICS 858, 859 (2008).

3. *Id.* at 864.

4. *Id.*

5. P. G. Brown et al., *A 500-Kiloton Airburst Over Chelyabinsk and An Enhanced Hazard From Small Impactors*, 503 NATURE 238 (2013). During the solar system's formative years, Earth was bombarded by asteroids. The barrage tapered off, but asteroids of varying size continue to pellet the planet. *See* Rodney Gomes et al., *Origin of the Cataclysmic Late Heavy Bombardment Period of the Terrestrial Planets*, 435 NATURE 466–69 (2005). One asteroid left a crater 65 million years ago near the town of Chicxulub, in Mexico, causing the extinction event, which killed off the dinosaurs. For the seminal paper setting out this discovery, see Luis W. Alvarez et al., *Extraterrestrial Cause for the Cretaceous-Tertiary Extinction*, 208 SCI. 1095 (1980).

path.[6]

Asteroid detection is of the utmost importance in asteroid deflection because some asteroids can be detected with more notice than others.[7] Some are detected decades, years, or months in advance, while others are detected mere days before coming close to Earth.[8] The ability of asteroids to suddenly appear, leaving little time to respond to a potential impact, will strain internationally coordinated efforts to deflect a large incoming asteroid. The limits on available observation, the variables of the situation at hand (such as the asteroid's proximity to Earth and its size, speed, and angle), and the possibilities of human and system error, could seriously hinder an asteroid deflection mission.[9]

This Note addresses a specific type of asteroid deflection scenario: what if a spacefaring State were to make a decision—akin to the classic "trolley problem"—which caused an asteroid to be diverted from hitting one area of Earth to one that is less populated, but still inhabited by humans nonetheless? The trolley problem is a philosophical dilemma in which action meant to reduce harm is weighed against principles that bar the use of persons to achieve harmful results, under the doctrine of double effect.[10] An applicable iteration of the trolley problem is as follows:

> Six Innocents are trapped on a certain trolley track. . . . Down the hill from this track, and across the road, there's someone in his own backyard, sleeping in his hammock. Accidentally, [a missile] has been launched. If you do nothing, your first option, the missile will land where the six are and, upon impact, it will kill them[.] By pushing a remote control button, you can reroute this missile, [causing it to] land in the noted yard and, upon impact . . . kill the yard's owner [and] destroy his entire house and yard[.][11]

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6. Vasile & Colombo, *supra* note 2, at 858–59.

7. Henry Fountain, *Better Asteroid Detection is Needed, Experts Say*, N.Y. TIMES (Mar. 20, 2013), http://www.nytimes.com/2013/03/21/science/space/better-asteroid-detection-needed-experts-say.html?_r=0 (last visited Jan. 22, 2016).

8. *See* Press Release, Nat'l Aeronautics & Space Admin., NASA Scientists Talk About Asteroids Passing Near Earth Wednesday (Sept. 7, 2010) (http://www.nasa.gov/home/hqnews/2010/sep/HQ_M10-128_Asteroids_Pass_By.html).

9. *See infra* Parts I(A)(i), I(A)(iii).

10. The doctrine of double effect is held to state either that, "sometimes it is permissible to cause a harm as a side effect (or 'double effect') of bringing about a good result even though it would not be permissible to cause such a harm as a means to bringing about the same good end[,]" or that, "for certain categories of morally grave actions, for example, causing the death of a human being, [there exists] a special permission for incidentally causing death for the sake of a good end (when it occurs as a side effect of one's pursuit of that end) with a general prohibition on instrumentally causing death for the sake of a good end . . . " Alison McIntyre, *Doctrine of Double Effect*, STAN. ENCYCLOPEDIA PHIL. (2004–14), http://plato.stanford.edu/entries/double-effect/ (last visited Mar. 17, 2015).

11. PETER UNGER, LIVING HIGH AND LETTING DIE 98–99 (1996).

For asteroid deflection, this question crosses over from the philosophical to the justiciable in the existing body of binding international space law, including the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (hereinafter "Outer Space Treaty")[12] and the Convention on International Liability for Damage Caused by Space Objects (hereinafter "Liability Convention").[13] Agreements like these, as well as newer informal agreements on technical aspects of spacefaring activity, answer some of the questions surrounding damages in general, including member state liability.[14] But none addresses the specific responses that States might make to claims for damages caused by asteroid deflection. Analyzing the liability a State incurs for deflecting an asteroid can help resolve claims for damages.

This Note argues that the Liability Convention should be amended to provide that (a) any State Party or intergovernmental organization that carries out an asteroid deflection operation will be held strictly liable for causing the loss of life and property within any State when it acts with the purpose of substituting lower damage in that State for higher damage in its own territory (perhaps with the accommodation of a liability cap); (b) claims of liability and damages under the Convention—which would normally go to an Article XIV Claims Commission—should instead be referred to the International Court of Justice (ICJ); and (c) liability arising from deflection should reflect Article XII principles of fairness and equity between spacefaring and non-spacefaring States, since the former States will likely have more influence in such a plan than the latter, while the latter are more susceptible to being hit by asteroids. Proactively forming a system of liability with the support of representative and procedurally sound adjudication in advance of its need will give stakeholders useful clarity on crucial legal issues, and ease the international planning and cooperation that will be necessary in the unlucky event that an asteroid collides with Earth.

Part I of this Note offers a brief background on near-Earth asteroids and the current status of asteroid deflection capabilities. It proceeds to discuss the development of principles of notice and consultation, and outlines the pertinent treaties and customary international law on outer space. It then compares key means of international dispute resolution

12. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

13. Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, 10 I.L.M. 965 [hereinafter Liability Convention].

14. *See* Outer Space Treaty, *supra* note 12, art. XIII; Liability Convention, *supra* note 13 arts. I–III.

and assesses how they have fared in assigning liability in similarly contentious cases. Finally, it briefly examines the topic of a liability cap, as exists in national governance of commercial space activity.

Part II analyzes the possibilities for a substantive update to the outer space liability regime. It first offers a definition of "space object," which allows for application of the Liability Convention to asteroid deflection in a "trolley problem" scenario where an asteroid is deflected from a high-population zone to a low-population zone [hereinafter "High-to-Low"]. Then it shifts focus to justifying strict liability and resolving the competing issues of fairness and equity between spacefaring and non-spacefaring States.[15] It then argues the logistical and political necessity of a specific, binding amendment to the Liability Convention, shows how the table has been set on the international stage for such an amendment, and lays out the incentives that all states have in accepting a compromissory clause referring all such disputes to the ICJ. Considerations of duty toward endangered peoples, notice to states whose populations are in danger, and constraints on scientific certainty in a mission will all be central to designing a liability system, which adheres to existing principles of international law. Part III also offers possible language for an amendment to the Liability Convention assigning liability for international damages arising from asteroid deflection and referring such cases to the ICJ. Part IV concludes.

I. BACKGROUND

A. *Asteroid Impacts, Means of Deflection, and Constraints on Decision Making*

i. Categorizing asteroids and the effects of colliding with them

Scientists believe that there may be over 1,000 asteroids larger than one kilometer wide in the solar system.[16] Unfortunately, ground-based observatories have limited resources and capabilities and many hazardous asteroids are "lost" by trackers for long periods, making it harder to calculate the odds of an asteroid strike on Earth.[17] Although chances are very low that an NEO will strike in any given year, NEOs' death rate (on average, as NEOs do not strike the Earth each year) is similar to

15. *See, e.g.*, Evan Seamone, *When Wishing on a State Just Won't Do: The Legal Basis for International Cooperation in the Mitigation of Asteroid Impacts and Similar Transboundary Disasters*, 87 IOWA L. REV. 1091, 1129–30 (2002) (discussing the United States' plan to intervene in the emergency descent of Skylab in 1979 in order to spare densely-populated India from the effects of a crash-landing in its territory).

16. Vasile & Colombo, *supra* note 2, at 858.

17. *Id.* at 859, 864.

more traditional hazards, like death by fire, drowning, or accidental firearm discharge.[18] This striking comparison arises from the odds of a large NEO hitting the Earth—four times per one million years—coupled with the staggering potential death toll it could have—one billion deaths per strike.[19] The deadliest NEOs are wider than 150 meters, with minimum orbit intersection distances (MOIDs) of less than 0.05 astronomical units (AUs) from Earth.[20] The NEO-tracking community knows of about 770 PHAs; among them is one of the most high-profile specimens in recent history, that of 99942 Apophis, a 300–400 meter asteroid that has a small chance of colliding with the Earth in 2036.[21] With a width of 300-meters and a bulk density of 2.7 grams per cubic centimeter,[22] 99942 Apophis exemplifies the type of asteroid that comes within the purview of this Note.

The destructive effects of an asteroid's impact depend on factors including its size, density, and velocity.[23] Asteroids that may have globally destructive effects on human civilization start out between one and two kilometers. A "typical" small-to-medium 200-meter asteroid, in comparison—traveling, say, 20 kilometers per second with a density of three grams per cubic centimeter—may cause blast damage, fires, earthquakes, and/or tsunamis upon colliding with Earth.[24] An asteroid ten times wider would bring destruction of another magnitude—killing up to a quarter of the global population.[25] To prevent or reduce such damage, scientists need unimpeded access to vast amounts of scientific data. But, if their capabilities and funding are limited, as is sometimes the case, decision makers at all levels will be forced to contend with un-

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18. Michael B. Gerrard & Anna W. Barber, *Asteroids and Comets: U.S. and International Law and the Lowest-Probability, Highest Consequence Risk*, 6 N.Y.U. ENVTL L.J. 4, 4, 12–13 (1997).

19. *Id.* at 12.

20. Vasile & Colombo, *supra* note 2, at 864. The MOID is defined as "the minimum distance between the [simplified] orbits of two objects," generally "indicat[ing] the closest possible approach of the two objects . . . ." Bruce Koehn, *Minimum Orbital Intersection Distance*, LOWELL OBSERVATORY (Oct. 4, 1996),
http://www2.lowell.edu/users/elgb/moid.html (last visited Mar. 30, 2016). An AU is equal to the distance from the Earth to the Sun—roughly 150 million kilometers. *Astronomical Unit (AU)*, NAT'L AERONAUTICS & SPACE ADMIN. (Feb. 28, 2015),
http://neo.jpl.nasa.gov/glossary/au.html (last visited Jan. 22, 2016).

21. Steven R. Chesley, *Potential Impact Detection for Near-Earth Asteroids: The Case of 99942 Apophis (2004 MN4)*, Asteroids, Comets, Meteors Proceedings, International Astronomical Union Symposium No. 229 (2005), at 215–16; Vasile & Colombo, *supra* note 2, at 864.

22. Chesley, *supra* note 21, at 215, 222.

23. Garshnek et al., *supra* note 1, at 213–14.

24. *Id.* at 214, 216.

25. *Id.* at 214. (This Note, however, is not primarily focused on asteroids of that size or larger.)

certainty when making specific and pivotal judgments.[26] These are the kinds of judgment calls that may come into evidence when a tribunal determines a State's liability for loss of life and property. Such adjudication would ideally occur under standards affirmed in advance, so that States may make informed decisions in a High-to-Low scenario.

One key variable to consider is whether the impact takes place on land or in an ocean. Ocean impacts are three times likelier to occur than land impacts, and are projected to cause fatalities and damage in densely populated coastlines.[27] Once it is predicted whether an asteroid will touch down in an ocean or on land, governments will have to take actions for mitigation (e.g., evacuation, food and water stockpiling, energy source protection, enforcement of order, public awareness campaigns), alongside potential deflection missions.[28] In the event of an impact—whether or not the asteroid is diverted from Point A to Point B on Earth's surface—sorting through the wreckage may involve rebuilding infrastructure, restoring agriculture, providing aid, managing public health,[29] and creating a complex framework for international cooperation in an emergency response.[30]

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26. *See generally* Yohei Sugimoto et al., Hazardous Near-Earth Asteroid Mitigation Campaign Planning Based on Uncertain Information on Fundamental Asteroid Characteristics at the 2013 IAA Planetary Defense Conference (Apr. 17, 2013) (discussing asteroid impact mitigation approaches that address various uncertainties); *see also* Gerrard & Barber, *supra* note 18, at 19, 45 (noting issues including the danger of system malfunction or sabotage, as well as probabilistic impact risks related to global surface area); *see also* Traci Watson, *NASA Drops Partnership with Private Asteroid Hunt*, NATURE (Sept. 29, 2015), http://www.nature.com/news/nasa-drops-partnership-with-private-asteroid-hunt-1.18462 (discussing NASA's withdrawal of funding for a private foundation's NEO detection project); Clara Moskowitz, *Asteroid Threat Collides with Earthly Budget Realities in Congress*, SPACE (Mar. 19, 2013), http://www.space.com/20292-asteroid-threat-earth-congress.html (quoting Gen. William Shelton, commander of the U.S. Air Force Space Command as noting that Federal budget cuts have made the United States "less capable" in NEO-monitoring).

27. Garshnek et al., *supra* note 1, at 215.

28. *Id.* at 218–19.

29. *Id.* at 220.

30. Leaders of decision-making bodies have labored to develop frameworks for cooperation with other entities in order to mitigate the risk of natural disasters like asteroids. The United States, for example, is looking at the asteroid problem in advance, if not yet the specific issue of liability. The United States enacted a statute in 2008 directing the White House's Office of Science and Technology Policy (OSTP) to "develop a policy for notifying Federal agencies and relevant emergency response institutions of an impending [NEO] threat," and to recommend a federal agency to protect the U.S. from NEOs and "implement[] a deflection campaign, in consultation with international bodies, should one be necessary." 51 U.S.C. § 71103 (2012).

In response, the Office of Science and Technology Policy's policy document, published in October 2010 (fittingly, on the day of the statutory deadline) recommends that NASA and the Department of Homeland Security (DHS) "play a key role in the continued development and review of pre- and post-impact response plans as capabilities evolve[,]" that agencies work with private stakeholders to "leverage work already performed" on NEOs, and "engage other nations and multilateral forums." Letter from John P. Holdren, Director, Office of Sci. & Tech. Policy, to Bart Gordon & Ralph M. Hall, Representatives, U.S. House of Representatives (Oct. 15, 2010)

ii. General methods of asteroid deflection

The above scientific issues will figure prominently in the choice of whether or not to attempt an asteroid deflection. It will likewise be necessary to select a method. Options for deflection include, but are not limited to, (1) kinetic impact and (2) dual deflection.

Kinetic impact is the simplest kind of strategy, aimed at increasing an asteroid's distance from Earth at the time its orbit comes near ours.[31] This is achieved by hitting the asteroid with a small spacecraft (or, in some scenarios, a nuclear explosive) to alter its course—like striking one ball with another on a billiard table.[32] Logistical constraints on the use of kinetic impact include the amount of warning time that scientists and decision-makers have to work with, and the eccentricity of the asteroid's orbit (the degree to which it is elliptical rather than circular) such that, the longer the warning time, the greater (and more successful) the deflection.[33]

In a dual deflection, kinetic impact remains the primary method but is supplemented by a secondary "slow-push," which uses the force from lasers or probes to push an asteroid further off-course.[34] In one example of a slow-push mission, a large spacecraft playing the role of a "gravity tractor" might fly close to the asteroid and use its mass to alter the path of the rock.[35] But, tugging an asteroid slowly usually requires longer-term planning and data collection.[36] In a scenario with low warning, NASA would likely need to resort to computer models to "predict the characteristics of . . . threats as they are detected" and plan a deflection without examining the asteroid firsthand.[37] Use of a nuclear kinetic impact would require the least amount of information or warning time because a nuclear device can provide the highest amount of energy at once. From a practical standpoint, the slow-push technique is rarely useful.[38]

(on file with author) (relating to NASA Authorization Act of 2008 § 804).

31. Vasile & Colombo, *supra* note 2, at 859.

32. *Id.*

33. *Id.* at 859–60, 868.

34. Sugimoto et al., *supra* note 26, at 2, 14; NAT'L AERONAUTICS & SPACE ADMIN., REPORT TO CONGRESS: NEAR-EARTH OBJECT SURVEY AND DEFLECTION ANALYSIS OF ALTERNATIVES 4 (2007), http://www.nasa.gov/pdf/171331main_NEO_report_march07.pdf [hereinafter NASA NEO SURVEY].

35. *See* NASA NEO SURVEY, *supra* note 34, at 21.

36. *See id.* at 10; *see also* WILLIAM AILOR, EARTH THREATENING ASTEROIDS: ISSUES AND FUTURE ACTIONS 13 (2008) (graphing the force required to deflect an asteroid against the days left until its meeting with earth, and showing that the amount of force necessary to reduce the risk of collision rises exponentially when approximately a year or less remains between the deflection and the projected meeting with Earth; creating more distance also requires applying more force).

37. NASA NEO SURVEY, *supra* note 34, at 10.

38. *See id.* at 20–21. It should be noted that the use of nuclear weapons with little warning,

iii. International notice and consultation in asteroid deflection

In a national emergency, a decision-maker's management of public concern is often a lower priority than its response to the threat itself.[39] A State's concern is doing first and foremost what it can to protect its population from the most dire forms of harm.

It is worth exploring to what degree the prioritization of action over public concern remains valid on the international stage. On the issue of asteroids, some argue that a government should maintain calm by "withhold[ing] information of a known asteroid or comet threat if there is no way to intercept the object[,]"[40] though the ethical soundness of such secrecy is certainly suspect from a policy perspective.

The issue of notice gives rise to another question: how much consultation must a State undertake with affected States if it knows that an asteroid is coming but it can be intercepted and deflected? What liability could a State incur for providing other states with improper notice or engaging in closed and hasty planning? Would States consider adopting a system of strict liability based on causation, similar to the kinds being proposed for damages caused by climate change?

Predicting what principles will be invoked by States to support or block a liability regime will direct us to central provisions of the Outer Space Treaty, Liability Convention, informal agreements, and international policy documents. Some ground has been covered, but gaps remain in the ongoing effort to reckon with this low-profile but tremendous threat. A High-to-Low scenario, wherein a State or group of States is confronted with the sudden choice to divert an asteroid at the expense of another State, would likely reflect the international failure of detection and preliminary attempts to mitigate, including asteroid track-

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even for the geopolitically agreeable purpose of blowing up asteroids, would still be expected to generate some legal and political controversy. For example, the issue of atmospheric radiation should not go neglected. Pollution from space activities can affect both Earth's atmosphere and surface, as in the cases of failed object launches and of crashed satellites carrying enriched nuclear fuel. *See* David Goren, *Nuclear Accidents in Space and on Earth: An Analysis of International Law Governing the Cosmos-954 and Chernobyl Accidents*, 5 GEO. INT'L ENVTL. L. REV. 855, 861–63 (1993).

39. *See* Cass R. Sunstein, *On the Divergent American Reactions to Terrorism and Climate Change*, 107 COLUM. L. REV. 503, 519–20, (2007) (discussing the administration of President George W. Bush's decision to elevate public concern after the September 11, 2001 terrorist attacks). Additionally, a decision maker's ability to perform cost-benefit analysis and incorporate it into legislation or rulemaking is constrained by its obligations to the public, which evaluates risk in less objective ways and values short-term over long-term priorities. This discrepancy looms large over efforts to combat climate change, for instance, as well as other problems whose impacts are delayed rather than immediate, and whose risks are "involuntarily incurred and uncontrollable." *Id*. at 521–22.

40. Evan R. Seamone, *The Duty to "Expect the Unexpected": Mitigating Extreme Natural Threats to the Global Commons Such as Asteroid and Comet Impacts With the Earth*, 41 COLUM. J. TRANSNAT'L L. 735, 773 (2003).

ing and surveys by a probe on the asteroid, computer modeling, and use of space- or ground-based monitoring systems.[41] International organizations and scholars of space law have begun to pick at the resulting questions of notice to, consultation of, and assistance to endangered populations,[42] but many remain unanswered.

The issues of preparatory consultation and notice are distinct but related. International disaster response law currently addresses both natural disasters and man-made disasters through United Nation organizations. These include the Office for the Coordination of Humanitarian Affairs (OCHA), as well as coalitions of states, including the North Atlantic Treaty Organization (NATO).[43] Few treaties exist, however, on a specific international right to public information and consultation in decisions impacting the environment, in the ways that a High-to-Low deflection would likely entail (causing, for instance, tsunamis or earthquakes). One is the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters [hereinafter Aarhus Convention].[44] Article 5(1)(c) of the Aarhus Convention, specifically, provides:

> In the event of any imminent threat to human health or the environment, whether caused by human activities or due to natural causes, all information which could enable the public to take measures to prevent or mitigate harm arising from the threat and is held by a public authority is disseminated immediately and without delay to members of the public who may be affected.[45]

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41. *See* John C. Kunich, Lt. Col., USAF, *Planetary Defense: The Legality of Global Survival*, 41 A.F. L. REV. 119, 127 nn. 35–36 (1997).

42. *See* Comm. on the Peaceful Uses of Outer Space, Scientific and Technical Subcomm., Rep. on its Forty-Eighth Session, Feb. 7–18, ¶¶ 17–20, U.N. Doc. A/AC.105/C.1/L.308 (Dec. 16, 2010); *see also* Gregory Shaffer & Melvin C. Steen, *International Law and Global Public Goods in a Legal Pluralist World*, 23 EUR. J. INT'L L 669, 676 (2012) (providing the only instance found, at time of writing, of legal writers inquiring about the role of international law in a High-To-Low—in which deflection into an ocean raises tsunami risks); *see also* Seamone, *supra* note 40, at 783–84 (exploring the possibility that, based on "tradeoffs between legal and policy doctrine that relate to both the source of the problem . . . and the effects of the harm[,]" possible policy options "may support both providing advance notice of harm to others" and "assisting potential victims of harm revealed by remote sensing." Whether these are simply options or affirmative duties under the existing international law is a key, unsolved question); *see also* Seamone, *The Precautionary Principle as the Law of Planetary Defense: Achieving the Mandate to Defend the Earth Against Asteroid and Comet Impacts While There Is Still Time*, 17 GEO. INT'L ENVTL. L. REV. 1, 17 (2004) (asserting that treaty law pertaining to nuclear and radiological assistance would point to liability on the part of a country that "intentionally alters the course of [an] object into the territory of another nation to protect its own interests.").

43. *See generally* Alejandra de Urioste, *When Will Help Be On the Way? The Status of International Disaster Response Law*, 15 TUL. J. INT'L & COMP. L. 181 (2006).

44. Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, June 25, 1998, 2161 U.N.T.S. 447 [hereinafter Aarhus Convention].

45. *See id.* art. 5.

Article 6 mandates that parties inform their publics, "either by public notice or individually as appropriate, early in an environmental decision-making procedure, and in an adequate, timely and effective manner," of the nature of possible decisions; opportunities, times, and venues for participation; and information about trans-boundary impacts.[46] There is, however, a big national defense carve-out; a party "[m]ay decide, on a case-by-case basis if so provided under national law, not to apply the provisions of this article to proposed activities serving national defence purposes, if that Party deems that such application would have an adverse effect on these purposes."[47]

This treaty is both broader in scope than the Liability Convention and too limited. It applies to a delineated set of activities including the commissioning of nuclear plants, metal ore and industrial chemical installations, and commercial oil and gas extraction, but also to "[a]ny activity not covered . . . where public participation is provided for under an environmental impact assessment procedure in accordance with national legislation."[48] It also has a narrow membership, with only 47 parties—all European and Asian States.[49]

Generally, international disaster law as a whole lacks coherence and efficiency, bends under the weight of political considerations,[50] and appears to be targeted toward coordination of post-disaster relief rather than toward preparatory mutual decision making. In a High-to-Low scenario, which is covered by nothing akin to the Aarhus Convention, these shortcomings will likely be acutely felt. The next Section discusses the body of space law, which might be extended to mitigate them.

B. *The Existing Body of Public International Space Law*

i. The Outer Space Treaty

The Outer Space Treaty represents the foundation of international space law. It has 103 States Parties[51] and its purpose has been to "contribute to broad international co-operation in the scientific as well as the

46. *See id.* art. 6.

47. *See id.*

48. *See id.* at 470.

49. United Nations, *Status of the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters as at 14 March 2015*, https://treaties.un.org/pages/viewdetails.aspx?src=treaty&mtdsg_no=xxvii-13&chapter=27&lang=en (last visited Mar. 20, 2015).

50. *See* de Urioste, *supra* note 43, at 194–99.

51. Comm. on the Peaceful Uses of Outer Space, Status of International Agreements Relating to Activities in Outer Space as at 1 January 2014, U.N. Doc. A/AC.105/C.2/2014/CRP.7, at 10.

legal aspects of the exploration and use of outer space for peaceful purposes" and "further the purposes and principles of the [UN] Charter[.]"[52] The Treaty bars any "national appropriation by claim of sovereignty"[53] and directs that States Parties explore and use outer space "in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security . . . "[54]

Article VII sets out a basic liability rule,[55] which was later expounded by the Liability Convention. The Treaty also requires full public disclosure of "the nature, conduct, locations, and results" of outer space activities—which would in all likelihood apply to asteroid deflection.[56] All provisions of the treaty apply to activities conducted by a single State or a partnership of states.[57]

ii. The Liability Convention

The Liability Convention defines "damage" as "loss of life, personal injury, or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical[.]"[58] The Convention then provides that a State which launches a space object and causes damage on the surface of the Earth "shall be absolutely liable to pay compensation" for such damage.[59] (For damage done elsewhere than on Earth's surface—for example, to another State's man-made space object, the launching State must have been at fault to incur liability.[60]) This two-

52. Outer Space Treaty, *supra* note 12, at 2411.

53. *Id.* art. II.

54. *Id.* art. III.

55. *Id.* art. VII ("Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space[.]").

56. *Id.* art. XI. The duty to provide notice to the "Secretary-General of the United Nations as well as the public and the international scientific community" is limited by what is "feasible and practicable[.]" What is feasible and practicable in the instance of an imminent impact event could end up being a substantive matter adjudicated by the ICJ on a liability claim. For a discussion of the drafting of Article XI, see Paul G. Dembling & Daniel M. Arons, *The Evolution of the Outer Space Treaty*, 33 J. AIR L. & COM. 419, 446 n.127 (detailing the disagreement between the U.S. and the U.S.S.R. over whether reporting should be mandatory, and noting that the sole areas of agreement on mandatory reporting, before reaching the compromise language of "feasible and practicable," included "phenomena discovered in outer space or on celestial bodies which might endanger the life or health of astronauts" and "potentially harmful experimens" [sic]). It should be noted that those two areas of agreement substantially intersect with the scenario of discovering an asteroid and carrying out a novel plan to deflect it.

57. Outer Space Treaty, *supra* note 12, art. XIII.

58. Liability Convention, *supra* note 13, art. I.

59. *Id.* art. II.

60. *Id.* art. III.

tier liability regime provides for compensation in accordance with "international law and the principles of justice and equity[.]"[61] Joint and several liability applies when "two or more States jointly launch a space object[.]"[62] The Convention further states in Article XXI that, "[i]f the damage . . . presents a large-scale danger to human life or seriously interferes with the living conditions of the population[,] the States Parties, and in particular the launching State, shall examine the possibility of rendering appropriate and rapid assistance to the State which has suffered the damage[.]"[63] This last provision seems to contemplate immediate emergency aid rather than High-to-Low-related judicial remedies, which again directs consideration as to what kind of liability to impose in order to determine the scope of those later remedies.

To apply the provisions of the Liability Convention and other agreements to an asteroid deflection scenario, it is helpful to note that analysis of the treaty will occur under the lens of the Vienna Convention on the Law of Treaties [hereinafter the Vienna Convention], which governs the observance, application, interpretation, and binding authority of treaties. The Vienna Convention has binding force on 114 States[64]—though not leading spacefaring States like the United States or France. But, it has been accepted as stating the customary international law in treaty construction[65] and offers useful principles—including for treaties concluded before its entry into force, such as the Liability Convention and Outer Space Treaty.

iii. Other relevant agreements

Outside of these treaties, the United Nations has adopted several non-binding principles and declarations to encourage States to peacefully use and explore space in state and commercial endeavors.[66] But, while

61. *Id.* art. XII.

62. *Id.* art. V.

63. *Id.* art. XXI.

64. United Nations, *Status of the Vienna Convention on the Law of Treaties*, https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXIII-1&chapter=23&lang=en (last visited Mar. 13, 2016).

65. *See, e.g.*, RESTATEMENT (THIRD) OF THE FOREIGN RELATIONS LAW OF THE UNITED STATES, Introductory Note (1987). The Restatement also incorporates several articles of the Vienna Convention, including arts. 31(1) (in § 325), 57 (in § 333), and 62 (in § 336).

66. Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries, G.A. Res. 51/122, U.N. Doc. A/AC/105/572 Rev. 1 (Dec. 13, 1996) [hereinafter Declaration on International Cooperation]. In relevant part, the Declaration on International Cooperation states:

> 4. International cooperation should be conducted in modes that are considered most effective and appropriate by the countries concerned, including, *inter alia*, governmental and non-governmental; commercial and non-commercial; global, multilateral, regional

texts like the Declaration on International Cooperation in the Exploration and Use of Outer Space [hereinafter Declaration on International Cooperation] offer informal bases for collective decisions in a time of emergency, they are also criticized for "self-judging exceptions"—that is, loopholes.[67] These exceptions allow States to determine when they may deviate from the principles in the declarations.[68] Issues that have been the subject of this kind of informal agreement over the past few decades include the use of nuclear power sources (NPS) in outer space[69] and mitigation of man-made orbital debris leftover from spacecraft accidents and rocket launches.[70] As commercial activities in space and the presence of space objects both grow, issues like these will likely be subject to further declarations, agreements, and domestic statutes.

For principles that may guide stakeholders in clarifying the Liability Convention for the specific event of an asteroid deflection, it will be helpful to look at the range of forums available to claimants of damages arising therefrom, as well as relevant prior rulings in these forums, and tools available in domestic law (e.g., liability caps) to shape and manage asteroid deflection liability.

C. *Forums, Adjudication, and the Application of Liability and Equity*

i. The Claims Commission

The Liability Convention already provides a forum in which to adjudicate claims within the treaty's purview—the Claims Commission. The Claims Commission, as per Article XV, has three members: "one appointed by the claimant State, one appointed by the launching State and the third member, the Chairman, to be chosen by both parties jointly."[71] Each party must select its member within two months of the initial request for a Claims Commission, or else the Chairman will constitute a single-member Claims Commission.[72] As Article XVII states, the

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or bilateral; and international cooperation among countries in all levels of development.

67. Brian Wessel, *The Rule of Law in Outer Space: The Effects of Treaties and Nonbinding Agreements on International Space Law*, 35 HASTINGS INT'L & COMP. L. REV. 289, 296 (2012). This problem is exacerbated by the state of affairs wherein, although States may elevate these informal agreements to international customary law in part by way of practice, "space-faring states have consistently stated that compliance with nonbinding space agreements is not required by international law." *Id.* at 298. As Wessel notes, "[u]nfortunately, in some areas [such as orbital debris mitigation] they seem to be becoming more the rule than the exception[.]" *Id*. at 319.

68. *Id.* at 296.

69. *See generally* Principles Relevant to the Use of Nuclear Power Sources in Outer Space, G.A. Res. 47/68, U.N. Doc. A/RES/47/78 (Dec. 14, 1992) [hereinafter NPS Principles].

70. *See generally* U.N. Office for Outer Space Affairs, Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, U.N. Doc. A/AC.105/C.1/I.260 (2002).

71. Liability Convention, *supra* note 13, art. XV(1).

72. *Id.*

Claims Commission will not increase in size if two or more claimant States join together in one proceeding.[73] Moreover, the blanket provision that the Commission "shall determine its own procedure" appears unsuited for the task of adjudicating a claim with more globally distributed consequences and likely more complex factual scenarios and decision-making processes than the drafters of the Convention contemplated.[74]

The Claims Commission has jurisdiction over the claim's merits and determines compensation,[75] but Article XIX limits the binding force of the Commission's rulings to cases where "the parties have so agreed[.]"[76] The alternative—"a final and recommendatory award, which the parties shall consider in good faith"[77]—fails to meet the scope of this problem. Fortunately, the Liability Convention's amendment process is straightforward: "[a]ny State Party . . . may propose amendments . . .[which] shall enter into force for each State Party to the Convention accepting the amendments" at the time that a majority of States Parties have accepted the amendments.[78] Therefore, while an amendment would not be universally effectual as to all States Parties, assembling enough States (especially spacefaring nations) could make the proposition viable. Before getting to the substance of the amendment, however, we must consider the main alternative for an existing, binding, natural forum—the ICJ.

ii. The International Court of Justice

The Statute of the International Court of Justice [hereinafter ICJ Statute] provides that the Court is composed of "a body of independent judges, elected [by an absolute majority of the General Assembly and of the Security Council] regardless of their nationality . . . ." but accounting heavily for character and expertise.[79] While the Claims Commission numbers three (in normal circumstances) or one (if opposing parties fail to timely name their members), and only hears a single claim at a time, the ICJ seats fifteen members, all from different states, for terms of nine years.[80] Like the Claims Commission, the ICJ decides cases on

73. *Id.* art. XVII. If two States join in a proceeding, they shall "collectively appoint one member of the Commission" as a single State would do.

74. *See infra* Part II(a)(iii); Liability Convention, *supra* note 13, art. XVI(3).

75. Liability Convention, *supra* note 13, art. XVIII.

76. *Id.* art. XIX(2).

77. *Id.*

78. *Id.* art. XXV.

79. Statute of the International Court of Justice, June 26, 1945, 59 Stat. 1055, 3 Bevans 1179, arts. 2, 4(1), 10(1) [hereinafter ICJ Statute].

80. *Compare id.* arts. 3(1), 13(1), *with* Liability Convention, *supra* note 13, art. XV(1).

a majority basis,[81] but unlike the Claims Commission, the ICJ's ruling has binding effect by default on the parties to the case.[82] The ICJ also takes a more permissive stance than the Claims Commission with respect to parties, providing that a state believing that it "has an interest of a legal nature which may be affected by the decision in the case" may request permission to intervene.[83]

Though comparing the Liability Convention and ICJ Statute is instructive, we would be remiss not to examine a pair of cases that shed further light on the question of what forum is best for asteroid deflection liability disputes: Rainbow Warrior and Cosmos-954. These cases will show how the forum in which a dispute is resolved has a strong influence on the parties' mutual satisfaction with the solution. In disputes over international responsibility for intentional actions causing loss of life and property, like a High-to-Low deflection, resolution by means of a single arbitrator and diplomatic negotiation pose jurisdictional and procedural problems. These issues are most likely to be resolved definitively and equitably in a binding forum, and the ICJ is more suitable than the Claims Commission in this respect.[84]

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81. *Id.* art. 55(1).

82. *Id.* art. 59.

83. *Id.* art. 62(1).

84. For adjudicatory bodies, this Note chooses to narrow its focus to treaty-established forums. The comparison between the subject-specific, procedurally deficient, generally non-binding Claims Commission and the generally competent, procedurally sufficient, binding ICJ is intended to illustrate the benefits of having a forum with the traits of the ICJ in advance of a crisis with the possible transboundary repercussions of an asteroid deflection. Jurists recognize that, in international law, establishing an *a priori* natural forum is harder than in domestic law, due to the lack of of territorial connecting factors that can lend such a forum natural jurisdiction. *See*, *e.g.*, Joost Pauwelyn & Luiz Eduardo Salles, *Forum Shopping Before International Tribunals: (Real) Concerns, (Im)Possible Solutions*, 42 CORNELL INT'L L.J. 77, 115 (2009). But, while Pauwelyn & Salles note that "the struggle for [finding an] international . . . or natural forum is likely to operate on the basis of the subject matter of the dispute, rather than the geographic origin of the relevant facts or the nationality of the parties," here the struggle is likelier to operate on the geographic origin of the facts and parties' nationalities, due to the particularly spatial nature of an asteroid deflection crisis. For further insight on the crisis-derived legitimation of international forums, see generally Suzanne Katzenstein, *In the Shadow of Crisis: The Creation of International Courts in the Twentieth Century*, 55 HARV. INT'L L.J. 151, 155 (2014) (finding that, "when born of legal crises, international courts are bridges that link fragile legal rules and norms of the past to their institutionalization and enforcement in the future"). Katzenstein's study shows that successful courts form when states perceive a legal crisis; hence the initial failure to create a Permanent Court of International Justice (PCIJ) before World War I, its success after the War—when the weakness of obligations on neutrality and sovereignty had come to light—and the collective epiphany that war could have been forestalled by creating a binding, international court beforehand. *Id.* at 169–76.

iii. Responsibility and liability—adjudication and principles

1. Binding arbitration via a single official (*Rainbow Warrior*)

The events leading up to the *Rainbow Warrior* decision are, briefly, as follows: in 1985, French secret service agents who sank a civilian vessel in Auckland Harbor, New Zealand, were charged in New Zealand with manslaughter and willful damage to a ship, and sentenced to ten years in prison.[85] The governments of New Zealand and France agreed to submit the dispute over the French agents' treatment to the U.N. Secretary-General for a binding arbitration.[86] The Secretary-General ruled that France was responsible for the sinking of the ship, violating New Zealand's territorial sovereignty, and breaking international law; subsequently, custody of the agents was transferred to France.[87] This case is notable for elevating the Secretary-General as a settler of disputes.[88] A ruling like this can also apply in substance to an array of tortious or criminal conduct, considering its grounding in the doctrine *ex aequo et bono* ("in justice and fairness"), which provides for flexibility in adjudication.[89]

However, France and New Zealand only accepted the Secretary-General's assistance for a small-in-scope dispute arising from the unexpected criminal actions of one state's officers. The ICJ, which did not try *Rainbow Warrior*,[90] has the authority to decide cases on principles of equity (as well as based on treaties, customs, or general principles),[91] and this Note will further examine how the ICJ would be better positioned to adjudicate a large-in-scope High-to-Low case than a single figure like the Secretary-General (or the Claims Commission).

2. Diplomacy and the Liability Convention (Cosmos-954)

A more applicable but equally cautionary binding settlement came about when the Soviet Union's nuclear-powered satellite, Cosmos-954, plummeted from its orbit and disintegrated over uninhabited areas of Canada, spreading debris and the amount of radiation emitted in the

85. Jodi Wexler, *The Rainbow Warrior Affair: State and Agent Responsibility for Authorized Violations of International Law*, 5 B.U. INT'L L.J. 389, 389–90 (1987).

86. *Id.* at 390.

87. *Id.* at 411. Rainbow Warrior is noted for advancing the principle that parties carrying out criminal acts pursuant to state orders are culpable—the "superior orders" argument notwithstanding.

88. Rainbow Warrior, Wexler asserts, "serve[s] as an example to states, who do not accept compulsory jurisdiction of the I.C.J., that arbitration by the Secretary-General is a viable method for peaceful resolution of international disputes." *Id.*

89. *See id.* at 401, n. 116.

90. *See id.* at 411.

91. ICJ Statute, *supra* note 79, art. 38(1), 38(2).

atomic bombing of Hiroshima, Japan.[92]

After the incident, the Canadian government presented its claim for damages and radioactivity cleanup costs to the U.S.S.R. via diplomatic channels rather than through an existing judicial institution, and settled for three million Canadian dollars—about half its initial request.[93] Because the U.S.S.R. admitted to owning the satellite, strict liability applied, as per Article II.[94] Despite its admission of ownership (but not fault), the U.S.S.R. argued that it should have to pay only for property loss—not cleanup costs.[95]

Had Canada's claim not been settled, Article XIV of the Liability Convention would have triggered the creation of a Claims Commission.[96] The Commission, however, lacks binding authority unless such authority is stipulated to by all parties.[97] Had it been triggered and assembled, the Commission would have comprised a Canadian member, a Soviet member, and a Chairman to be chosen by both parties jointly, as per Article XV(1).[98] But one can also go beyond what the Liability Convention foresaw, and imagine a conflict amongst multiple states claiming severe damages from a High-to-Low deflection. In such a scenario, the member-selection process could easily go awry. Not only could there be disagreement as to the number of members, since Article XV(1) only provides for three, but also the Secretary-General could be called upon to step in and select a Chairman herself as provided by Article XV(2); each scenario could dredge up the sort of unpredictable political conflict that the Claims Commission was designed to prevent.[99]

In the event that a spacefaring state performs a High-to-Low asteroid deflection, the resolution may be as clear-cut as it was between France and New Zealand in *Rainbow Warrior*, and counterparties will not be likely to find satisfaction in diplomatic settlement as in the case of Cosmos-954, given the vastly higher magnitude of the claims to be

92. Canada: Claim Against the Union of Soviet Socialist Republics for Damage Caused by Soviet Cosmos 954, Note No. FLA-268, dated January 23, 1979 (Department of External Affairs), reprinted in 18 I.L.M. 899; *see also* Goren, *supra* note 38, at 863–64 (applying principles from the Cosmos-954 settlement to environmental law).

93. Edward G. Lee & D. W. Sproule, *Liability for Damage Caused by Space Debris: The Cosmos-954 Claim*, 26 CAN. Y.B. INT'L L. 273, 273–74 (1988).

94. *Id.* at 275–76.

95. *See* Goren, *supra* note 38, at 890.

96. Liability Convention, *supra* note 13, art. XIV; Lee & Sproule, *supra* note 93, at 279.

97. Liability Convention, *supra* note 13, art. XIX(2).

98. *Id.* art. XV(1) ("The Claims Commission shall be composed of three members: one appointed by the claimant State, one appointed by the launching State and the third member, the Chairman, to be chosen by both parties jointly.").

99. *See* Lee & Sproule, *supra* note 93, at 274 n.4 (noting that the settlement between Canada and the U.S.S.R. was based on "past lump sum settlements, the desirability of prolonging negotiations, and the various political considerations . . . .").

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D. *Principles from Space Activity Insurance Regimes—Liability Caps*

To compare these relatively amorphous international liability regimes with more specific domestic ones, it helps to look toward the United States in its role as a global leader of commercial space transportation. The United States has developed relevant policy on activities such as the launching of telecommunications satellites and delivery of supplies to the International Space Station. For example, liability insurance and financial responsibility requirements for commercial launches are set out in the Commercial Space Launch Act Amendments of 1988, codified at 51 U.S.C. §50914.

Subsections (a)(1) and (a)(3), specifically, cover the total claims related to a single launch or reentry, stating that the recipient of a launch/reentry license:

> [I]s not required to obtain insurance or demonstrate financial responsibility of more than . . . (i) $500,000,000 [for the maximum probable loss from claims by a third party for death, bodily injury, or property damage or loss resulting from an activity carried out under the license]; or (ii) $100,000,000 [for the maximum probable loss from claims by the U.S. government against a person for damage or loss to government property resulting from such activity].[100]

The U.S. government, however, is on the hook for sums greater than the requirements posed by (a)(1)(A), up to an appropriated amount of $1,500,000,000, inflation-adjusted.[101] It is impossible to tell how the CSLA insurance/responsibility requirements would stack up against claims arising from a High-to-Low event, but the types of damage contemplated by a 200-meter asteroid strike (earthquakes, fires, tsunamis) may go above and beyond those that would remain covered under an international liability cap that is anywhere near as low as the billion-dollar level.

For the purposes of equity, in a specific way that counterbalances the general principles of global fairness, spacefaring states will want to examine the possibility of liability caps—even though doing so may serve to block harmed states from receiving a substantial part of their claims' monetary value.

It is the truly hard cases—like High-to-Low scenarios—that are likeliest to be so intractable that they cannot be settled out of court. As the next Part of this Note argues, a High-to-Low scenario should be met with a binding system of liability and adjudication in place.

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100. 51 U.S.C. § 50914(a)(1)(A)–(B)(3).

101. 51 U.S.C. § 50915.

II. ANALYSIS

This Part will begin by discussing the systems of liability and compensation that can be used to implement a workable system for asteroid deflection. Next, it will weigh the benefits and drawbacks of implementing a system of liability by means of binding treaty or nonbinding agreement. Finally, it will show that an amendment to a currently existing binding treaty (the Liability Convention) establishing a system of liability will (1) deal best with the combination of long-term planning and unexpected exigencies posed by a High-to-Low scenario, (2) satisfy binding international obligations, and (3) best fulfill the principles of fairness and equity.

Liability normally has two aims: compensation to victims for past harms and prevention, by means of deterrence, of future harm.[102] For asteroid deflection, relying on the prospective effects of international liability to deter states from harming populations will be premature because this situation is unprecedented,[103] and because the need for a quick reaction and decision-making process will likely make a policy of deterrence even less a concern than the need for international notice of a deflection and adequate opportunity for consultation (see Part I(a)(iii), *supra*). Therefore, it is important to determine what liability scheme best fulfills the goal of compensation for victims.

In simple terms, the scenario proposed here is that of a State victim (or victims) suffering direct impact (or indirect tsunami) damage from an intentional act of asteroid deflection and bringing a liability claim to an international tribunal with binding authority against the deflecting State(s). While systems that adjudicate this type of claim have been established, they have been seldom tested. For example, Article 14 of the United Nations Framework Convention on Climate Change (UNFCCC), like the Claims Commission in Article XIV of the Liability Convention, provides that parties to the UNFCCC may unilaterally accept the ICJ as a compulsory dispute forum, but also arbitrate within the treaty framework.[104] So far, "very few [S]tates have made a[n Article 14] declaration"[105] and there is little reason to imagine that States would make similar declarations after a claim has arisen in a High-to-Low event.

Strict liability for damages on Earth's surface has been applied to the

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102. Michael G. Faure & André Nollkaemper, *International Liability as an Instrument to Prevent and Compensate for Climate Change*, 26A STAN. ENVTL. L.J. 123, 139–40 (2007).

103. *See id.* at 141 (noting that the deterrence element of international liability for damages arising from climate change is likewise weak because "significant awards of compensation have been extremely rare.").

104. *Id.* at 129 n.17.

105. *Id.* at 128–29.

transportation of ultrahazardous materials,[106] as well as transboundary harms due to nuclear accidents,[107] and can be readily transposed to asteroid deflection. The Liability Convention already contains a two-tier liability system but, as previously noted, issues arise in applying the Convention, as currently written, to asteroid deflection.[108] The first subsection dispenses with the definitional roadblock of what comprises a "space object," while the second offers the main argument for strict liability in a binding forum.

A. *Updating the Outer Space Liability Regime*

i. Broadening the definition of "space objects"

Before the main procedural defect of the Liability Convention is remedied so that an asteroid deflection claim is assured to be binding, its parties must first change the treaty so that it can cover asteroid deflection. Namely, its overly narrow definition of "space objects" must be broadened. The Liability Convention's conception of a "space object" includes "component parts of a space object as well as its launch vehicle and parts thereof."[109] This recursive definition (that of a space object being defined by its own component parts) can only be read so as to encompass launch vehicles and satellites. It certainly does not include objects retrieved from outer space and manipulated by humans.[110] Because that category of object is now far closer to technological reality than it was during the drafting of the Liability Convention,[111] the exclusion should be removed. The exclusion obstructs the creation of a liability regime for High-to-Low scenarios.

Professor Henry R. Hertzfeld proposed a new definition of "space object," which also includes "anything that human beings have modified or moved in space and/or brought back to Earth and re-launched into space."[112] Amending parties should simply strike the element of relaunch in order to make this language apply neatly to asteroid deflection. Doing so would modernize the Liability Convention not only with regard to asteroid deflection, but also for a wide variety of possible

106. Goren, *supra* note 38, at 890–91.

107. Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage, Sept. 12, 1997, 36 I.L.M. 1462.

108. Liability Convention, *supra* note 13, arts. II–III; *supra* Part I(c)(iii).

109. Liability Convention, *supra* note 13, art. 1(d).

110. HENRY R. HERTZFELD, A ROADMAP FOR A SUSTAINABLE SPACE LEGAL REGIME (2012), https://www.gwu.edu/~spi/assets/docs/Hertzfeld-IISL%20Paper-Revision%2011-30-2012.pdf.

111. *See* Nat'l Aeronautics & Space Admin. *The Long and Storied Path to Human Asteroid Exploration*, (Apr. 16, 2013), http://www.nasa.gov/topics/history/features/asteroids.html.

112. HERTZFELD, *supra* note 110, at 5.

commercial ventures involving asteroids, such as water and mineral extraction.[113] While this new definition would raise the prospect of liability for commercial activities gone awry as well as for damage caused by deflection meant to protect populations from naturally occurring space phenomena, the merits of that debate have no particular bearing on this one.

Once an asteroid is characterized as a space object by the Liability Convention, extending the existing liability standard to asteroid deflection—and finding a binding, standing forum in the ICJ—are no longer premature, with an asteroid liability regime susceptible to the vagaries of textual interpretation.

ii. Substantive rules and justification for international strict liability

1. Strict liability, as opposed to other standards

Strict liability consists of a simpler factual inquiry than does negligence; here it would require only some proof that an action in one territory caused damage to occur in another territory.[114] Strict liability is also easier "to apply consistently on a global level" than negligence.[115] Therefore, strict liability is a good place to start—especially in situations like an asteroid deflection, where target States may have little influence on the risk they must bear pursuant to international negotiations and planning.[116]

Ease of application is, of course, not the only factor in favoring strict liability. The normative weight of a deliberate decision to perform a High-to-Low deflection—with the intent to substitute harm in one place for harm in another, under the constraints of imperfect data—is at least as important.

The signal sent by such a choice from the deflecting state to the target State is that of a unique sort of triage, aggravated by the deflector's choice to displace the emergency from its own territory. This deliberate intent invokes one of the most common justifications for strict liability—that intentional tortfeasors should bear the costs of acts done in pursuit of harm-avoidance.[117] This rationale makes sense in the case of

113. *See generally* Scott J. Shackelford, *Governing the Final Frontier: A Polycentric Approach to Managing Space Weaponization and Debris*, 51 AM. BUS. L.J. 429 (2014) (discussing the deficiencies in the current treaty system in governing the increasingly abundant and complex interaction of commercial and military space objects).

114. Goren, *supra* note 38, at 891.

115. *Id.* (arguing that "[d]ifferent countries with different cultures may have differing understandings of what constitutes a duty of 'reasonable care,' and therefore they may disagree whether a certain case fits the standard of negligence.").

116. Faure & Nollkaemper, *supra* note 102, at 150.

117. *See generally* Guido Calabresi & Jon T. Hirschoff, *Toward a Test for Strict Liability in*

a State acting in defense of its population. Strict liability does not remove a State's right to act, but ensures that it does not simply act and automatically impose all costs on another State. But the standard as written in the Liability Convention applies to accidents[118] Work must be done to justify application to purposeful actions for asteroid deflection. Parties must also reckon with the reality that spacefaring States (in the quite literally cosmic sense) have no influence over the risk foisted on them.

Some have proposed that there should be an affirmative duty for leading spacefaring nations to protect other states from asteroids.[119] Such a duty might be analogous to the tentative norm of responsibility to protect (R2P) civilian populations from mass human rights crimes, and might attach to the United States and other technologically equipped States because their technological advances have "created an expectation of protection."[120]

But the duty here would differ significantly. R2P covers mass atrocities, and only comes into play when a government has failed to protect its citizens from such atrocities.[121] Also, a deflection duty would lack the status of customary international law because no State has ever acted to deflect an asteroid (thereby failing to satisfy the state practice prong of CIL),[122] and there is little reason to think that *opinio juris* could adequately undergird such a duty in a short timeframe.[123] There-

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Torts, 81 YALE L.J. 1055 (1972).

118. Liability Convention, *supra* note 13. The Liability Convention notes that, "notwithstanding the precautionary measures to be taken by States and international intergovernmental organizations involved in the launching of space objects, damage may on occasion be caused by such objects[.]" The word "precautionary" and the attribution of damage to space objects both evince application to accidents rather than intentional acts.

119. *See, e.g.*, Justin L. Koplow, *Assessing the Creation of a Duty Under International Customary Law Whereby the United States of America Would Be Obligated to Defend a Foreign State Against the Catastrophic but Localized Damage of an Asteroid Impact*, 17 GEO. INT'L ENVTL. L. REV. 273, 279, 303 (2005) (discussing the possibility of, but ultimately rejecting, an affirmative duty obligating the United States to defend foreign states from asteroids between 50 meters and 1-2 kilometers in diameter—"too large to be fended off by Earth's atmosphere, but too small to pose a global threat[,]" and also theorizing that spacefaring powers acting in good faith could be exempt from liability).

120. *Id.* at 285, 287–95.

121. G.A. Res. drft. referred to the High-level Plenary Meeting of the General Assembly by the General Assembly at its Fifty-Ninth Session, U.N. Doc. A/60/L.1 (Sept. 20, 2005), ¶¶ 138–39.

122. Koplow, *supra* note 119, at 302.

123. Frederic L. Kirgis, Jr., *Custom on a Sliding Scale*, 81 AM. J. INT'L L. 146, 149 (1987) ("As the frequency and consistency of the practice decline in any series of cases, a stronger showing of an *opinio juris* is required."). Because this is an unprecedented situation, *opinio juris* of the highest order is needed. On one hand, "[t]he more destabilizing or morally distasteful the activity . . . the more readily international decision makers will substitute one element for the other[.]" *Id.* This theoretically clears the way for *opinio juris* to assume the position of CIL. But, when the interests of the deflector and target states so manifestly diverge as in a High-to-Low,

fore, other principles will likely need to be invoked before any action is taken.

Foremost among these will be the right to national self-protection. This is especially true in the likely event of a conflict of political wills over who should bear the costs both before and after impact, and when there is no mechanism yet in place for adjudication. Even in the face of such conflict, strict liability provides a compelling standard for the international community. Draft principles adopted by the International Law Commission in 2006[124] provide one example of "allocat[ion of] risk of loss due to harm resulting from lawful economic or other activities" and "ensur[ing] prompt and adequate compensation for the victims of transboundary damage caused by lawful hazardous activities" under strict liability.[125]

One principle to justify action may come from UNFCCC, Article 3(3), which etches out a precautionary principle for action to mitigate the causes and impacts of climate change: "[w]here there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing [mitigation] measures."[126] For asteroids, a natural phenomenon that poses public safety, health, and structural threats that echo those of climate change[127]—albeit far more suddenly—importing this principle makes pragmatic sense. Still, parties must account for the lack of certainty in success for a deflection mission, as well as the influence of deflecting states' input and intent, in a way that suits the purpose of devising the appropriate evidentiary standard for asteroid damages.

In the likely case that two or more States act jointly in an asteroid deflection, joint-and-several liability would be immensely complex, particularly as states point to the actions or political and logistical input of each potentially liable state in the course of executing a mission.[128] That may simply be the unavoidable cost of a fair hearing in which all the details inherent in the planning of a High-to-Low deflection are

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this route should not be presumed open.

124. Int'l Law Comm'n., Draft Principles on the Allocation of Loss in the Case of Transboundary Harm Arising out of Hazardous Activities, Principle 6.2, Rep. on the Work of Its Fifty-Eighth Session, U.N. Doc. A/61/10 (Oct. 1, 2006) [hereinafter Draft Principles].

125. Alexandre Kiss & Dinah L. Shelton, *Strict Liability in International Environmental Law* 1139 (Geo. Wash. Univ. L. Sch. Pub. Law & Legal Theory Working Paper No. 345, 2007).

126. United Nations Framework Convention, S. Treaty Doc No. 102-38, 1771 U.N.T.S. 107, art. 3(3) [hereinafter Framework Convention].

127. *See* World Health Organization, *Climate and Health Fact Sheet No. 266*, (Aug. 2007), http://www.who.int/mediacentre/factsheets/fs266/en/.

128. *See* Faure & Nollkaemper, *supra* note 102, at 170 ("[A] victim may well encounter difficulties in proving a causal link between the action of every particular tortfeasor and the . . . damage she suffered.").

made public. Whatever evidentiary threshold and liability cap are chosen, weighing the evidence at a tribunal will benefit from the guidance of fairness and equity principles written into the Liability Convention beforehand, discussed in the next section.

2. Affirming principles of fairness and equity

a. *Protecting spacefaring states—liability caps*

Liability caps represent one possible path forward on issues of certainty in causation, avoidance of under-deterrence or over-deterrence, and stronger adherence to an updated treaty. Useful examples of liability caps exist in domestic and intergovernmental laws enacted in the United States and elsewhere.[129] The relevant provisions of the CSLA Amendments Act of 1988, at 51 U.S.C. §§ 50914-15, (discussed in Section II(d), *supra*) were originally based on the Price-Anderson Act, 42 U.S.C. §2210 et seq., governing liability for the U.S. civilian nuclear power industry. While the policy goal of the CSLA Amendments was, at its outset, to promote U.S. commercial competitiveness, Congress has recently entertained interpreting the Act to describe obligations that the United States would face under the Liability Convention upon a third-party claim that private U.S. actors have caused damage in an accident.[130]

Attempting to extend liability caps to government-initiated High-to-Low asteroid deflections requires mindfulness of the purpose of §§50914-15. The above readings caution against wholesale importing a CSLA-style liability cap from commercial space activity to asteroid deflection. For one thing, the drafters of the U.S. statute assumed that chances of exceeding the required insurance amount, resulting in a government payout, were one in ten million.[131] It follows that a liability cap that specifically applies to a high-risk, high-damages scenario like asteroid deflection would steeply increase the probability and magnitude of a government payout, whether or not contractors and subcontractors are involved. Therefore, a liability cap would require justification under a significantly different rationale—likely involving the defense of action taken in good faith to prevent loss of life rather than any sort of commercial endeavor under the purview of the CSLA.

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129. *See, e.g.*, Austl. Space Indus. Chamber of Commerce, Submission to Senate Econ. Legislation Comm. on the Space Activities Amendment Bill 2002 7–8 (2002) (Austl.) (describing the similarly structured liability insurance/indemnity regimes established in the European Space Agency (ESA), People's Republic of China (PRC), Russia, and Japan).

130. *See* An Examination of Future Commercial Launch Markets and FAA's Launch Indemnification Program: Hearing Before the Subcomm. on Space & Aeronautics of the H. Comm. on Sci., Space & Tech., 112th Cong. 87 (2012) (hearing charter at 6–7).

131. *See id.* at 5.

Although the merits of good faith are beyond the scope of this Note, not even good faith necessarily precludes strict liability as the appropriate standard to apply. As Judge Calabresi wrote, "the need to establish [parties'] relative ability to [rationally engage in harm-avoidance] requires us to look realistically at the ability of . . . parties to *act* upon a perception that they are in risky categories."[132] If spacefaring States have a higher ability to act decisively on their perception of risk, the spacefaring States should shoulder the costs of compensation for their action.

Bearing this in mind, the next portion of this Note discusses a set of principles that militate toward placing liability in the hands of spacefaring States that have exercised the strongest influence in planning a High-to-Low asteroid deflection.

b. *Protecting non-spacefaring states—global fairness*

Strong parallels exist between climate change and asteroid deflection in terms of previously discussed issues such as (1) short- and long-term risk, (2) States' interests, and (3) deficiencies in available forums.[133] Furthermore, both issues demand consideration of States' "common but differentiated responsibilities and respective capabilities"[134] based on the asymmetrical build-up of technological and economic power available against the threat at hand. The world's economic powerhouses are the states that have emitted the most carbon, and they are also those that have the capabilities to respond to the threat their emissions have created.[135] Similarly, although the threat of asteroids does not arise from any type of human action analogous to carbon emissions, these States are still uniquely positioned to respond to them.[136] This asymmetry is particularly noticeable in the nuclear realm. As previously mentioned, nuclear is an oft-proposed means of deflection, but developing States are compelled (for separate, geopolitically understandable reasons) to re-

132. Calabresi & Hirschoff, *supra* note 117, at 1071 (emphasis in original).

133. *See supra* Parts I(A)(i),(iii) and I(C).

134. See Framework Convention, *supra* note 126, pmbl.

135. *See id.*, arts. 3.1 & 4.1, May 29, 1992, U.N. Doc. A/AC.237/18 (1992), http://unfccc.int/files/essential_background/convention/background/application/pdf/convention_text_with_annexes_english_for_posting.pdf.

136. Ben Baseley-Walker, *Responsible Launching: Space Security, Technology, and Emerging Space States*, SPACE REV. (Mar. 29, 2010), http://www.thespacereview.com/article/1596/1 (last visited Jan. 23, 2016) (listing major launching States to include the United States, Russia, China, India, and Japan. These countries all happen to comprise the top five worldwide carbon emitters. Union of Concerned Scientists, *Each Country's Share of CO2 Emissions*, (Nov. 18, 2014), http://www.ucsusa.org/global_warming/science_and_impacts/science/each-countrys-share-of-co2.html#.VqQ0WlMrJmA (last visited Jan. 23, 2016).

frain from advancing their nuclear capabilities.[137] The issue of technological asymmetry also comes up in relation to the issue of the air-space boundary (*infra*, note 156), which States could foreseeably invoke to dodge liability.[138]

International climate change liability—much like liability arising from space activity—is a nascent area of law, and therefore domestic liability principles have a great deal of potential to influence international liability principles in that area.[139] It would not be farfetched to suppose that the same should be true for asteroid deflection, for example, in making the argument to add such common domestic policies as strict liability and liability caps to a proposed Amendment to the Liability Convention.[140]

Others have spotted the parallel between the geographic risks of climate change and asteroid impacts but find it beside the point. They argue that, implicit in a State or group of States responding to an asteroid by trying to deflect it, is the assumption that "the risks of direct NEO impacts are distributed equally across the globe with respect to surface area."[141] While that may be true in a strictly spatial sense, it is another

137. *See, e.g.*, Nuclear Threat Initiative, *Muted Global Response Follows Indian Long-Range Missile Test*, NAT'L J. (Apr. 20, 2012), http://www.nti.org/gsn/article/not-much-criticism-seen-indian-long-range-missile-launch/; Council on Foreign Relations, *The Global Nuclear Non-proliferation Regime: Issue Brief*, (June 25, 2013), http://www.cfr.org/nonproliferation-arms-control-and-disarmament/global-nuclear-nonproliferation-regime/p18984 (both sources discussing the United States' and United Nations' efforts to discourage and compel states like India from proceeding with development of long-range nuclear-capable missile technology); Joseph Packer et al., *The Policy Trajectory of United States Asteroid Deflection Planning*, 1 TIMELY INTERVENTIONS 1, 4 (2013) (noting that some proposed means of deflection discussed supra Section II(a)(ii), such as usage of lasers and gravity tractors, "may lack the maturity of kinetic impactors or nuclear blasts . . .").

138. Indeed, over the past few years, national governments and the U.N Committee on the Peaceful Uses of Outer Space (COPUOS) have discussed solutions to this very issue, hoping for a framework applicable at international levels "before real problems occur[]." U.N. COPUOS, Draft report of the Chair of the Working Group on the Definition and Delimitation of Outer Space, U.N. Doc. A/AC.105/C.2/2011/DEF/L.1 (Apr. 1, 2011), at 2. Advanced and developing nations alike have opined on space delimitation. The United Kingdom and Armenia, for example, favor special legislation relating to specific missions. U.N. COPUOS, Questions on the Definition and Delimitation of Outer Space: Replies from Member States, U.N. Doc. A/AC.105/889/Add.13 (Nov. 29, 2013), at 3; A/AC.105/889/Add.8 (Dec. 9, 2010), at 3. Colombia, meanwhile, argues that current procedures "are neither equitable nor effective in ensuring access for developing countries[.]" U.N. COPUOS, Questions on the definition and delimitation of outer space: replies from Member States, U.N. Doc. A/AC.105/889/Add.12 (Mar. 6, 2013), at 3. Bolivia, similarly, is invested in the issue as a country just on the verge of [its] first spacefaring activities. U.N. COPUOS: Questions on the Definition and Delimitation of Outer Space: replies from Member States, U.N. Doc. A/AC.105/889/Add.11 (Jan. 28, 2013), at 4.

139. *See* Faure & Nollkaemper, *supra* note 102, at 129

140. *See* Goren, *supra* note 38, at 882–91 (arguing that environmental damage recovery mechanisms should be strengthened by drawing on models from space law, including the Liability Convention's rules on notice, safety, and strict liability).

141. Gerrard & Barber, *supra* note 18, at 45, n.185–87.

question entirely whether (a) the risks of direct NEO impacts are distributed equally between states and populations with advanced and developing—i.e., non-spacefaring—economies, and (b) whether developing states are as likely, or more likely, than advanced states to be the target of a deliberate deflection by an advanced state.

Developing countries comprise more than two-thirds of the Earth's land surface area.[142] This statistic must be considered in the two following lights: (1) if an asteroid is bound for land, it is twice as likely to impact a developing country than it is to hit an industrialized country, or (2) if an asteroid is bound for an industrialized country (or toward the oceans in a way that endangers an industrialized country), a deflection mission is more probable than not to target a developing country. Either conclusion poses an ethical dilemma similar in kind and magnitude to that faced by an increasingly mainstream contingent: advocates of large-scale geoengineering—or "deliberate large-scale [technological] manipulation of the environment"[143]—as a response to climate change.

In certain circles, large-scale solar radiation management (SRM) has gained notable traction as a last-ditch means of keeping global temperature increases below two degrees Celsius via geoengineering.[144] Like many projects of staggering geographical and atmospheric reach, SRM has potential adverse effects, including the drastic reduction of rainfall in areas of the world that depend on monsoons for their food and water supplies—particularly African and Asian countries.[145] Furthermore, because SRM is merely a stopgap, which, if lifted, would fully reintensify the greenhouse effect, technologically advanced States able to implement SRM programs would in effect be holding a "Sword of Damocles" over future generations in those areas of the world.[146] Indeed, as Canadian author Naomi Klein wrote in 2014, focusing on climate change and negative SRM impacts: "[n]o naturally occurring disaster *short of an asteroid* has such global reach."[147] And, like SRM, if an asteroid deflection ever occurred, it would "almost surely be in an atmosphere of col-

142. BEYOND CULTURAL IMPERIALISM: GLOBALIZATION, COMMUNICATION, AND THE NEW INTERNATIONAL ORDER 233 (Peter Golding & Phil Harris eds., 1996).

143. *See* David Biello, *What Is Geoengineering and Why Is It Considered a Climate Change Solution?*, SCI. AMER. (Apr. 6, 2010), http://www.scientificamerican.com/article/geoengineering-and-climate-change/.

144. William C.G. Burns, *Geoengineering the Climate: An Overview of Solar Radiation Management Options*, 46 TULSA L. REV. 283, 283, 286, 289 (2010). SRM focuses on "reducing the amount of solar radiation absorbed by the Earth by an amount sufficient to offset the increased trapping of infrared radiation by rising levels of greenhouse gases[,]" including through injecting large quantities of hydrogen sulfide or sulfur dioxide into the stratosphere. *Id.* at 286.

145. *Id.* at 290–91.

146. *Id.* at 297–98.

147. NAOMI KLEIN, THIS CHANGES EVERYTHING: CAPITALISM VS. THE CLIMATE 272–74 (2014) (emphasis added).

lective panic with scarce time for calm deliberation."[148] Finding common principles of global fairness and equity will be key to minimizing the damaging effects of such panic, and to ensuring that a decision-making structure exists that is sensible and accounts for the interests of all States.[149]

Those who have assessed the practical viability and ethical problems posed by SRM have trod the same path taken by this Note, arguing for a full system of notice and consultation, multilateral planning, compensation for all persons harmed, and an effective governance mechanism.[150] They call for these steps because climate change is an existential crisis whose magnitude has ballooned by means of entrenched interests, and whose mitigation must come from the representation of unempowered populations. Asteroids, on the other hand, certainly are not a problem created by humans, but they have been no less ignored. And a time might come when an approaching asteroid demands a one-off feat of brute technical force such as an internationally coordinated deflection mission. But, without giving voice to all interests involved, a global system facing the threat of a mid-sized asteroid could give in to its inequitable instincts and shut vulnerable States out of the process, to their possibly cataclysmic detriment—both in the pre-deflection planning process and during the aftermath of the emergency, when the costs of rebuilding become fully known.

Bearing in mind the geopolitical asymmetry in technological capability and decision-making leverage, strict liability makes sense as a way to encourage spacefaring States in charge of an asteroid deflection mission to take stock and accept concrete input from States who lack the technology to take direct action, but who occupy most of the Earth's land and are home to billions of its people. The role of a liability cap in this regime is less clear, but should definitely be subject to sustained discussion because of its place in ensuring fairness toward spacefaring as well as non-spacefaring states. Finally, empowering the ICJ to hear asteroid deflection claims would ensure that harmed countries have judicial redress, and lend needed legitimacy to the novel and complex process of High-to-Low planning. The need to persuade spacefaring States to assent to such a system, however, leaves certain issues unre-

148. *Id.* at 276.

149. *See* Adam D.K. Abelkop & Jonathan C. Carlson, *Reining in Phaëthon's Chariot: Principles for the Governance of Geoengineering*, 21 TRANSNAT'L L. & CONTEMP. PROBS. 763, 791 (2013).

150. *Id.* at 768, 804. Abelkop & Carlson float the idea of requiring a double majority (a majority of weighted votes plus a majority of all countries) for the implementation of global SRM; a similar mechanism would likely be inequitable in an asteroid deflection scenario because of the more direct targeting of geographic areas involved, unless weight were given to the target state(s), in which case such a system might instead be paralyzed.

solved, to be addressed in the following sections.

iii. Showing the need for a specific, exhaustive Liability Convention

Any proposal for a system of international asteroid deflection liability must balance the long-term requirement for legal clarity and predictability with the short-term need for flexibility in planning, compromise, and unforeseen circumstances.[151]

However, asteroid deflection poses a unique problem: in normal circumstances, the international community often favors law that is flexible enough to react to the conventional backdrop of changing circumstances and political exigencies. During a fast-moving, time-limited asteroid deflection scenario, on the other hand, endangered States should prefer limiting how much room the law has to change on a whim. The amount of delay that potential negotiation over the parameters of liability would cause to a deflection mission hinges upon the breadth and complexity of such negotiation. Therefore, one might reasonably ask whether the designers of a liability system should value specificity in a liability standard and forum over flexibility, or vice versa. This question is especially important, considering that one part of a liability regime (e.g., binding authority in the ICJ) may be used as a bargaining chip against an equally important part (e.g., provisions for joint-and-several liability), reducing the chances of forming a whole system.

Indeed, ambiguous but binding treaties "may be worse than nonbinding but substantively detailed agreements."[152] Many of these agreements provide sufficiently clear rules for activities such as orbital debris mitigation and NPS use in space,[153] but allowing nonbinding agreements with self-judging exceptions to form the backbone of a mature and situation-specific space liability regime may create more problems than it solves for a High-to-Low scenario.

An ambiguous amendment to the Liability Convention, for example, which sets out neither strict nor proportional liability, could make adjudication in any forum more fraught than need be, and also cloud decision making in the carrying out of a deflection mission. An amendment with a self-judging exception, also, would blow a gaping hole in a strict liability standard.[154]

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151. Wessel, *supra* note 67, at 315 (explaining that "flexibility to deal with unanticipated circumstances is an important value in any legal system, but it is especially so in international space law" due to "rapidly advancing" space technology and scientific opinion on best practices).

152. *Id.* at 316.

153. *Id.* at 318.

154. *Id.* at 319 (arguing that self-judging exceptions "would not be a great problem if they were limited to truly exceptional situations"); *see also* Christopher M. Petras, Lt. Col., USAF, *An*

The above considerations demand the resolution of other issues well before the need arises. For example, what happens when a state undertakes to suspend[155] or otherwise undercut the Liability Convention? What if one or more spacefaring States, while planning a mission that it believes would render it vulnerable to absolute liability for surface damage, tries to contest jurisdiction based on the air-space boundary,[156] or seeks to reduce its liability as in Cosmos-954? Even more dramatically, what if a State allows proceedings to go all the way to an Article XIV Claims Commission but declines to follow through with restitution

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Alternative Proposal to Modernize the Liability Regime for Surface Damage Caused by Aircraft to Assess Damage Resulting from Highjackings or Other Unlawful Interference, 10 GONZ. J. INT'L L. 315, 331–32 (2006–2007) (making the case that the "good faith" interpretation provisions of the Vienna Convention on the Law of Treaties may influence the efficiency of a liability treaty more than any coercive power underlying a final decision); Roger P. Alford, *The Self-Judging WTO Security Exception*, 2011 UTAH L. REV. 697, 750–51 (2011) (noting WTO members' general refusal to use the self-judging exception, in bad faith, of Article XXI(b)(iii) of the General Agreement on Tariffs and Trade (GATT) to suspend compliance with WTO rules for civilian goods by invoking necessity for security "in time of war or other emergency in international relations"). Alford theorizes that the normative influence of surrounding WTO rules, as well as rational choice theory, influence states' decisions not to abuse Article XXI(b)(iii)—as well as other states' choices not to object to "more dubious invocations," explain the general viability of self-judging exceptions like this, even on a global scale. *Id.* at 752–57. But opposing forces could govern an asteroid deflection. It is among the most exceptional of situations, does not entail any repeat-player effects, and, unlike WTO, has no well-tested legal framework to legitimate rules with loopholes.

155. Vienna Convention on the Law of Treaties arts. 30(3), 62(1), May 23, 1969, 1155 U.N.T.S. 331 [hereinafter Vienna Convention]: "A fundamental change of circumstances which has occurred with regard to those existing at the time of the conclusion of a treaty, and which was not foreseen by the parties, may not be invoked as a ground for terminating or withdrawing from a treaty unless: (a) the existence of those circumstances constituted an essential basis of the consent of the parties to be bound by the treaty; and (b) the effect of the change is radically to transform the extent of obligations still to be performed under the treaty." As discussed in Part II(A)(ii)((2)(b)(iii), *infra*, the drafters of the Liability Convention did not foresee the implication of the Liability Convention in asteroid deflection. Also, the non-threat of asteroids was an essential basis for the consent of the parties to be bound by the Liability Convention. *See* Richard Morrison, *Efficient Breach of International Agreements*, 23 DENV. J. INT'L L. & POL'Y 183, 214 (1994) (discussing Article 62(1)'s origin in the doctrine of rebus sic stantibus, which states relied on after World War II to terminate imperial treaties because of the loss of their colonies). If imperial treaties concluded before that war can be terminated because states did not foresee a war, it is even easier to imagine states suspending the Liability Convention because they did not foresee asteroids. Finally, the change of circumstances would certainly widen the extent of obligations under the Liability Convention by dramatically increasing the possible amount of damage to life and property, and liability for such damage.

156. Where individual States' jurisdiction over airspace ends, and outer space—not under sovereign jurisdiction—begins, is a central outstanding issue in international space law. While some believe that this boundary should vary from country to country based on each one's ability to control airspace, others argue that the boundary should reflect the natural logistics of spaceflight while dealing with the problem posed by the atmosphere's gradual thinning. *See* Theodore W. Goodman, *To the End of the Earth: A Study of the Boundary Between Earth and Space*, 36 J. SPACE L. 87, 89, 92 (2010). One possible solution, now utilized by NASA, is the point where a spacecraft begins to experience "noticeable drag" (air resistance) from the Earth's atmosphere—an altitude of about 76 miles (122 kilometers). *Id.* at 94–95.

because the Commission's decisions are nonbinding? In each of these scenarios, the community of nations could be thrown into geopolitical turmoil commensurate with the damage inflicted by an asteroid. If billions of dollars in damage were done, perhaps the world would see an escalating round of retaliatory sanctions. If instead a High-to-Low deflection results in damages totaling hundreds of billions or more, victim States' tolerance for structuring forums, standards, and remedies may wear even thinner, leading States to take more coercive actions.[157]

The Vienna Convention states that "[a] treaty shall be interpreted in good faith in accordance with the ordinary meaning given to the terms of the treaty in their context and in the light of its object and purpose."[158] The Liability Convention's drafters, however, never seem to have contemplated an asteroid deflection mission; rather, the Convention was meant to cover accidents, not purposeful acts.[159] The defense that harmful action was necessary in light of an approaching asteroid would be valuable for any State that had a hand in an asteroid deflection at any of the possible inflection points, whether in clashes over jurisdiction, the merits of the case being adjudicated, or restitution itself. However, not only did the Convention fail to cover purposeful acts, but it also failed to address natural disasters such as asteroids. Indeed, a 1965 draft proposal by Hungary provided that "exemption from liability [could] be granted only in so far as the State liable produce[d] evidence that the damage . . . resulted from natural disaster . . ."[160] Any mention

157. This is admittedly speculative, but only as much as research on international liability, self-help, and use of force in regard to climate change have been. *See, e.g.*, Jon Breed, *Climate Change will Make Issues Like Regional Instability, Extremism & Terrorism More Challenging*, AM. SECURITY PROJECT (July 31, 2014), http://www.americansecurityproject.org/climate-change-will-make-issues-like-regional-instability-extremism-and-terrorism-more-challenging-for-our-country/ (explaining that climate change damages will exacerbate the threats of "regional instability, extremism[,] and terrorism"); ACHIM MAAS & DENNIS TÄNZLER, REGIONAL SECURITY IMPLICATIONS OF CLIMATE CHANGE 2–3 (Jan. 2009), http://www.adelphi.de/files/uploads/andere/pdf/application/pdf/us_514_-_adelphi_synopsis_on_climate_change_and_security_09-01-15.pdf (summarizing the geopolitical knock-on effects of local conflicts over natural resources and the possibility of larger militarized disputes); *see also* Alexandra Knight, *Global Environmental Threats: Can the Security Council Protect Our Earth?*, 80 N.Y.U. L. REV. 1549, 1549–53 (2005) (imagining a scenario in which the U.N. Security Council takes coercive action to stop Brazil from engaging in deforestation in order to mitigate the security risks posed by climate change).

158. Vienna Convention, art. 31(1).

159. *See* Bryan Schwartz & Mark L. Berlin, *After the Fall: An Analysis of the Canadian Claim for Damage Caused by Cosmos 954*, 27 MCGILL L.J. 676, 707 (1982) (explaining that the history of the drafting of the Liability Convention indicates that it was "intended to be exhaustive" and resolve the uncertainties surrounding claimants' rights in cases of "unintentional intrusions").

160. U.N. General Assembly, Report of the Legal Sub-Committee on the Work of Its Fourth Session (20 September–1 October 1965) to the Committee on the Peaceful Uses of Outer Space, U.N. Doc. A/AC.105/29, Annex II (Oct. 1, 1965), at 3.

of natural disaster exoneration whatsoever fell out of the concluded Article VI.

These limitations of the Liability Convention, as it is currently written, suggest that a specific amendment to the treaty is merited in order to (1) place a useful limit on the length of negotiation that can take place after the start of a High-to-Low scenario, (2) protect the integrity of a strict liability standard, and (3) prevent a High-to-Low deflection from causing further economic and human damage due to post-deflection circumstances leading to armed conflict. Such a solution would be preferable to yet another nonbinding agreement or reliance on the treaty as it is currently written, with its weak Claims Commission and susceptibility to suspension or other judicial maneuvering.

iv. International willingness to update the Liability Convention

The U.N. International Law Commission (ILC) has in the past decade begun to map out how domestic laws and international remedies should play out in the wake of trans-boundary harm due to hazardous activities (into which category asteroid deflection could someday fall).[161] In a set of Draft Principles adopted in 2006, the ILC declared that, when one state's hazardous activities cause trans-boundary harms, the harmed body should have access to the same remedies that are available to citizens of the state committing the wrongdoing.[162] Also, when "particular categories of hazardous activities" occur, and "specific global, regional or bilateral agreements would provide effective arrangements concerning compensation, response measures and international and domestic remedies," the harmed State and harming State "[should make all efforts] to conclude such specific agreements."[163] Asteroid deflection bears many of the characteristics of such hazardous activity.

The substantive steps taken by the ILC in the general area of hazardous activities suggest that the international legal community would be open to discussing the negotiation of a regime for asteroid deflection, i.e., one of the "particular categories"[164] of hazardous activity that the Draft Principles state would be well served by an international arrangement. The Draft Principles suggest strict liability for transboundary damage due to hazardous activities.[165] They also push States to establish "industry-wide funds at the national level,"[166] bringing to mind the commercial space liability caps and insurance mandates discussed

161. *See generally* Draft Principles, *supra* note 124.
162. *See id.* at Principle 6(2).
163. *Id.* at Principle 7(1).
164. *Id.*
165. *See id.* at Principle 4(2).
166. *Id.* at Principle 4(4).

above.[167] The U.N. General Assembly has also recommended that spacefaring states "consider the conclusion of agreements in accordance with the Liability Convention with respect to joint launches or cooperation programmes[,]"[168] a measure which becomes relevant if a group of States chooses to undertake a deflection mission involving the launch of a space object.

The following Section addresses the process of finding a proper forum to hear claims arising from damages due to intentional actions performed in the course of a High-to-Low asteroid deflection. It will argue that all States, spacefaring and non-spacefaring, have an incentive to accept the jurisdiction of the ICJ in such disputes.

B. *Empowering and legitimating a binding international tribunal*

The issue of the tribunal's binding authority (or lack thereof) raises unanswered questions about the representativeness and accountability of the adjudicating body. The United States, the leading spacefaring power, has been notably hesitant to submit to international tribunals. In 2002, for example, the United States passed a law enabling it to invade The Hague to free U.S. personnel detained at the behest of the International Criminal Court (ICC).[169] Would it not be natural if the United States were reluctant to consent to being sued for saving lives from the catastrophic damage caused by an asteroid, a wholly natural phenomenon?

i. Practical incentives for great powers to engage in international law

It bears mentioning that, in 1963, during the earliest stages of negotiating the Liability Convention and before the Claims Commission was contemplated, the United States itself proposed that the ICJ "have jurisdiction to adjudicate any dispute relating to the interpretation or application of the [eventual] international agreement on liability in the absence of agreement between the States concerned upon another means of settlement[.]"[170] Would the United States' (and other States') stance now toward the ICJ in a High-to-Low deflection be as cold as the United States' stance has been toward the ICC? How would a state react toward a claim adjudicated by the Claims Commission? The U.S. delegation's historical progression touches on an issue of the utmost import: trust in the tribunal.

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167. *See supra* Part I(D).

168. G.A. Res. 59/115, ¶ 2 (Jan. 25, 2005).

169. *See* American Servicemembers' Protection Act of 2002, 22 U.S.C. § 7427.

170. Comm. on the Peaceful Uses of Outer Space, Rep. of the Legal Subcomm. on Its Second Session, U.N. Doc. A/AC.105/12, ann. I D(3)(e) (1963).

The foundation for such trust lies in the United States' and other countries' relationships with the rest of the world, as well as their rational security interests, which play out on an international landscape marked by a dearth of central enforcement mechanisms.[171] Actors motivated by this pragmatic view may assert their wills independent of what may be dictated by international law, choosing only to comply when doing so "coincide[s] with its interests."[172] For asteroid deflection, the goal of this Note is to bring international law and the wills of powerful, spacefaring and less-powerful, non-spacefaring states close together.

In this context, States' long-run reliance on these laws and institutions is based on incentives to (1) "shape the way in which cooperativeness is signaled through compliance with international law[,]" (2) "signal cooperativeness itself[,]" and (3) "avoid the sovereignty costs from having to comply" with costly non-domestic norms.[173]

In a pragmatic defense of the Alien Tort Statute (ATS), 28 U.S.C. §1350,[174] one scholar explains that the ATS was enacted in 1789 to keep the young United States' neutrality from being swept away by tortious incidents involving foreign nationals on U.S. soil.[175] When it comes to the ATS, the United States' provision of a jurisdictional hook and forum for human rights violations entails a "threat of liability" which is, in itself, a "global public good from which the United States benefits as a producer and consumer of global order."[176]

Though the ATS fell out of use for two centuries, "its mere existence may have provided some reassurance" to foreign nationals dealing with U.S. nationals on U.S. soil and abroad.[177] To be sure, the constraints on a young country seeking to build internal stability in a turbulent hemisphere are a far cry from those of a singular superpower providing what may be considered a "public good"[178] via asteroid deflection (depending on one's ethical reactions to the High-to-Low problem). States like the United States still benefit from laws like the ATS (and institutions like the ICJ and IMF) because their own "ability or willingness to provide

171. *See* Robert Knowles, *A Realist Defense of the Alien Tort Statute*, 88 WASH. U. L. REV. 1117, 1135 (2011).

172. *Id.* at 1136.

173. *Id.* at 1170.

174. *See* Alien Tort Statute (ATS), 28 U.S.C. § 1350 (2012) (stating with deceptive simplicity: "[t]he district courts shall have original jurisdiction of any civil action by an alien for a tort only, committed in violation of the law of nations or a treaty of the United States.").

175. Knowles, *supra* note 171, at 1163.

176. *Id.* at 1172.

177. *Id.* at 1164.

178. *Id.* at 1165.

these goods could one day be in doubt."[179] When Apollo 11 made the first manned moon landing in the Sea of Tranquility on July 20, 1969, did anyone think that the final such landing (so far) would take place a mere three years later?[180] The possibility that the development of asteroid deflection capabilities could be tentative, like the Apollo program, should offer all States an incentive to invest in a regime that offers them a measure of lasting security if their international influence and technical capabilities fall to a low ebb before an impact.[181]

Thus, a strong argument exists for a state to agree to an amendment to the Liability Convention, which brings claims of liability for damage arising from asteroid deflection to a binding commission, to be adjudicated under a standard of strict liability.

ii. Comparing the Claims Commission and ICJ in asteroid deflection

Deciding which forum is best suited to hear claims arising from asteroid deflection is a task whose solution owes to the nature of this particular scenario. Why should the ICJ hear such a claim, when the Claims Commission takes care of all the rest under the Liability Convention?

In considering the viability of these tribunals, the most urgent criteria are (1) representativeness and (2) readiness to adjudicate.

The Claims Commission (assuming that it is fully constituted, not in its single-member form) comprises the representative of the claimant state(s), that of the launching state(s), and the Chairman. Because the two parties must collaborate to choose a Chairman, one hopes that they would find a mutually satisfactory compromise. But the higher the damages, the less certain the contours of causation, and the greater the geographical spread, the more states there are to be dissatisfied. The ICJ is a fully representative tribunal, staffed by independent judges with high professional and moral standing, and a distribution of judges that happens to equitably balance global representation against the representation of spacefaring nations (i.e., those that are the permanent members of the U.N. Security Council).[182]

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179. *Id.* at 1167.

180. Apollo 17 was NASA's final manned lunar landing, taking place on December 19, 1972. Nat'l Aeronautics & Space Admin., *Apollo 17*, NASA (Apr. 7, 2011), http://www.nasa.gov/mission_pages/apollo/missions/apollo17.html#.VQNrHRDF8_M.

181. *See* Katzenstein, *supra* note 84, at 162 (arguing that legal crises open the door to cooperation in establishing forums which "shift[s] the priorities of states, making [them] more concerned with ensuring their own security and stability than guarding state sovereignty from third-party actors").

182. The ICJ maintains that "the Court as a whole must represent the main forms of civilization and the principal legal systems of the world." As such, the distribution of judges is "among the principal regions of the globe . . . : Africa 3, Latin America and the Caribbean 2, Asia 3,

Comparing the procedures of the two tribunals lends further support to the ICJ in terms of readiness to adjudicate. In light of the purpose of a regime of asteroid deflection liability, it seems self-defeating for States to bind themselves to a body which, lacking treaty limits, must take the time to "determine its own procedure" (Liability Convention, Art. XVI). Article 30 of the ICJ Statute, however, directed the ICJ to establish an extensive, standing set of rules of procedure, and it has done so.[183] Over 100 rules govern communications with the Court (Rules of Court, art. 31), the timing of filings and pleadings (art. 44), and the introduction and handling of testimony by expert witnesses and international organizations (arts. 57, 62–68). The ICJ's allowance for intervention (art. 81), moreover, should signal to interested states that they will not be arbitrarily shut out.

Each of these attributes credits the ICJ as a purveyor of binding decisions of the possible magnitude at issue in this Note. The ICJ's competency and versatility to decide this kind of case, in which states act with the intention of substituting the loss of their lives and property with that of other nations, is superior to that of the Claims Commission, and also to the ad hoc mechanisms seen in instances like Cosmos-954, where a diplomatic settlement disposed with the pivotal issue of Soviet liability behind closed doors, halving Canada's compensation.[184]

A State that has performed a High-to-Low deflection will ask why it should be liable for saving lives." But a target State will ask who gave the deflecting state the right to press the button. The ICJ is best suited to provide an inevitably imperfect, but still responsive, representative, and informed opinion on these issues.

C. *Proposal*

The following is a proposed draft amendment to the Liability Convention, articulating a standard of absolute liability for damages due to purposeful asteroid deflection, with provisions for joint-and-several liability, a broadening of the term "space object," and the referral of claims to the ICJ. Omitted is any provision for a liability cap. This proposal represents a mere starting point for the reader's consideration and is not meant to offer a definitive conception of what the final liabil-

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Western Europe and other States 5, Eastern Europe 2, which corresponds to that of membership of the Security Council. Although there is no entitlement to membership on the part of any country, the Court has always included judges of the nationality of the permanent members of the Security Council. Int'l Court of Justice, *Members of the Court*, http://www.icj-cij.org/court/index.php?p1=1&p2=2 (last visited Feb. 12, 2015).

183. *See* Revised Rules of the Court, 2007 I.C.J. Acts & Docs. No. 6, at 111 (emphasizing Part III Proceedings in Contentious Cases).

184. *See supra* Part I(C)(iii)(2).

ity regime should look like.

DRAFT AMENDMENT TO THE LIABILITY CONVENTION (ARTICLE XXIX)

1. In the event that a launching State has launched a space object with the purpose of deflecting an asteroid impact to avert direct damage to said State, knowing that such deflection may cause damage to a third State or to its natural or juridical persons, the launching State shall be absolutely liable to pay compensation for damage caused by its space object.

2. Whenever two or more States jointly launch a space object with the purpose of deflecting an asteroid impact to avert direct damage to said States, knowing that such deflection may cause damage to a third State or to its natural or juridical persons, they shall be jointly and severally liable for any damage caused.

3. In all cases of joint and several liability referred to in paragraph 2 of this article, the burden of compensation for the damage shall be apportioned among the States in accordance with the extent to which they were at fault.

4. For the purposes of this Article, the meaning of the term "space object" includes:

(a) The meaning given to the term under Article I(d);

(b) Anything that human beings have modified or moved in space and/or brought to Earth, including an asteroid.

5. A claim for compensation for damage arising under paragraphs 1 and 2 of this Article shall be referred to the International Court of Justice for adjudication.

CONCLUSION

In 1962, the Canadian diplomat Marcel Cadieux opined that the U.N. Committee on the Peaceful Uses of Outer Space (COPUOS) was "at the helm of a ship about to embark on the greatest voyage of discovery of all time . . ."[185] He believed that an established space law regime would "govern not only relations between States in outer space, but also relations between Earth as a whole and outer space[.]"[186] Cadieux had such high hopes for space law that he believed it could be made "free of all the imperfections marring the rule of law on earth over the past centu-

185. Comm. on the Peaceful Uses of Outer Space, Rep. of the Legal Subcomm. on Its Fourth Session, U.N. Doc. A/AC.105/C.2/SR.4 (1962), at 6 [hereinafter COPUOS Fourth Meeting Summary Record].

186. *Id.* at 6–7.

ries."[187]

A High-to-Low asteroid deflection requires an international liability system robust enough to provide for complex multi-level coordination to deflect an asteroid, maintain public order in affected states, and fairly and equitably adjudicate claims arising from this kind of deflection. Causing an asteroid to miss a larger population for a smaller one raises ethical dilemmas of the sort seen in war and peace[188] which, due to their unfamiliarity and devastation, may give rise to argument and recrimination.

This Note made the case that the Liability Convention should be amended to provide that States choosing to engage in asteroid deflection, with the object of reducing loss of life but causing loss of life elsewhere in the process, should be held strictly liable; that deflection claims should be heard in the ICJ—the most procedurally robust and globally representative established forum; and that remedies should reflect principles of fairness and equity between spacefaring and non-spacefaring States, accounting for the unique constraints faced by each category.

Cadieux, in expressing his optimism, indulged himself by searching outer space for a way of bringing global civilization into a new era of cooperation.[189] Whether or not an asteroid strikes the Earth, space may yet retain such promise. But that search is only the frame for space governance's most idealistic aspirations. The role of law will be, as it has always been, to prevent conflicts from worsening. Space law, like all law, will contain multitudes of flaws and will reflect the global community's conflicting priorities and competing impulses toward sovereignty and integration. This corner of space law, though it may govern the fallout from an unlikely chain of events unlike anything the world should ever want to see, will be grounded in mundane, earthly questions.

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187. *Id.* at 8.

188. *See* Sarah Bakewell, *Clang Went the Trolley: 'Would You Kill the Fat Man?' and 'The Trolley Problem'*, N.Y. TIMES (Nov. 22, 2013), http://www.nytimes.com/2013/11/24/books/review/would-you-kill-the-fat-man-and-the-trolley-problem.html?pagewanted=all&_r=0 (discussing the United States' use of atomic bombs on Japan in World War II as well as the study of trolley problems by cadets at the U.S. Military Academy at West Point).

189. *See* COPUOS Fourth Meeting Summary Record, *supra* note 185, at 6–7.